Energy and Renewables

Thomas Fend, German Aerospace Center, Institute of Solar Research

EWACC Building Bridges
Young Scholars' Forum (YSF), Nicosia, Cyprus, June 7 to 17, 2015

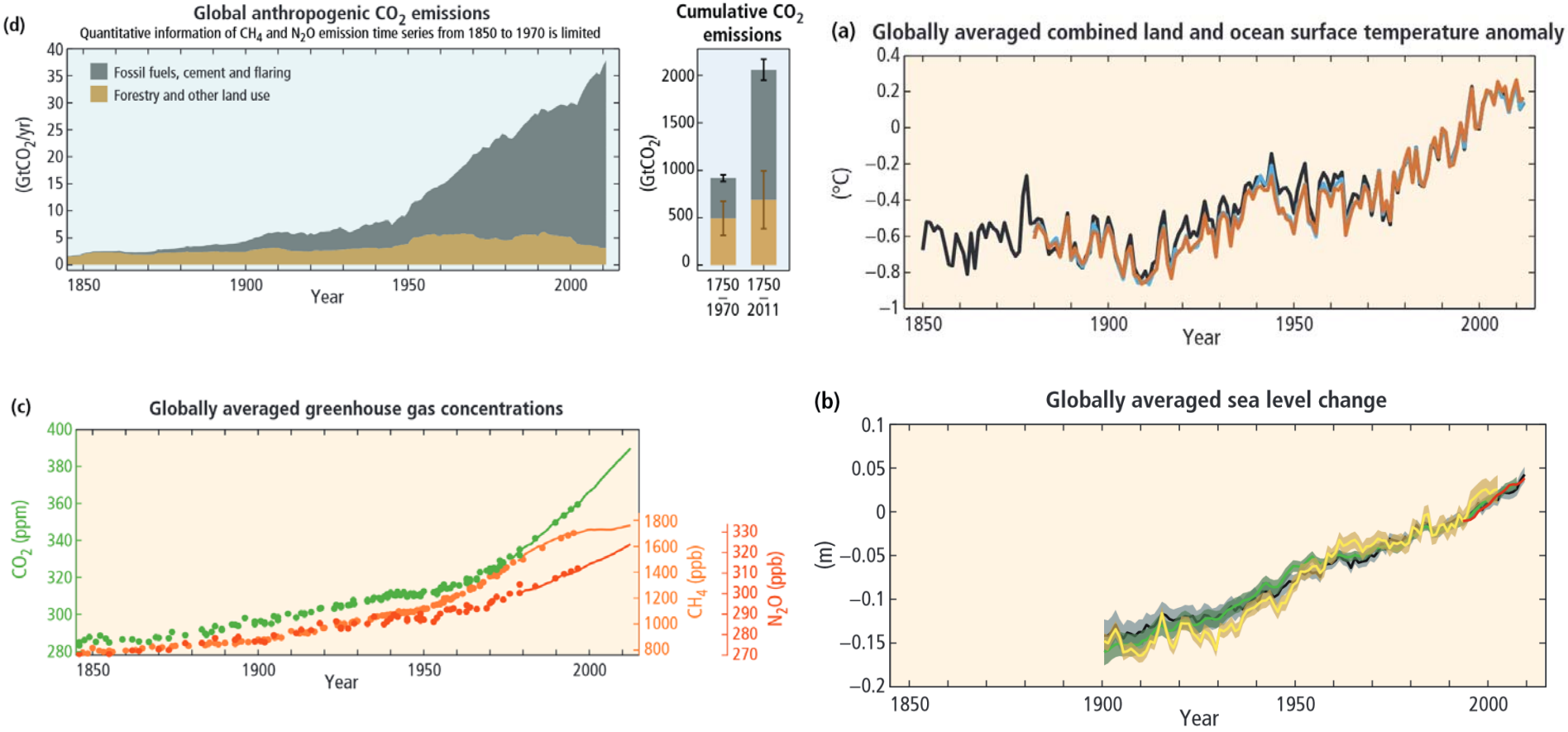
Deutsches Zentrum
DLR für Luft- und Raumfahrt e.V.
in der Helmholtz-Gemeinschaft

Outline

- Why is Renewable Energy (RE) interesting for young people?
- Which RE technologies are useful?
- What can Concentrating Solar Power (CSP) do?
- Why are RE important for MENA and EU?
- How can we support RE in MENA and Europe?

Why is RE interesting for young people?

climate change by greenhouse gas emissions



source: IPCC report 2014

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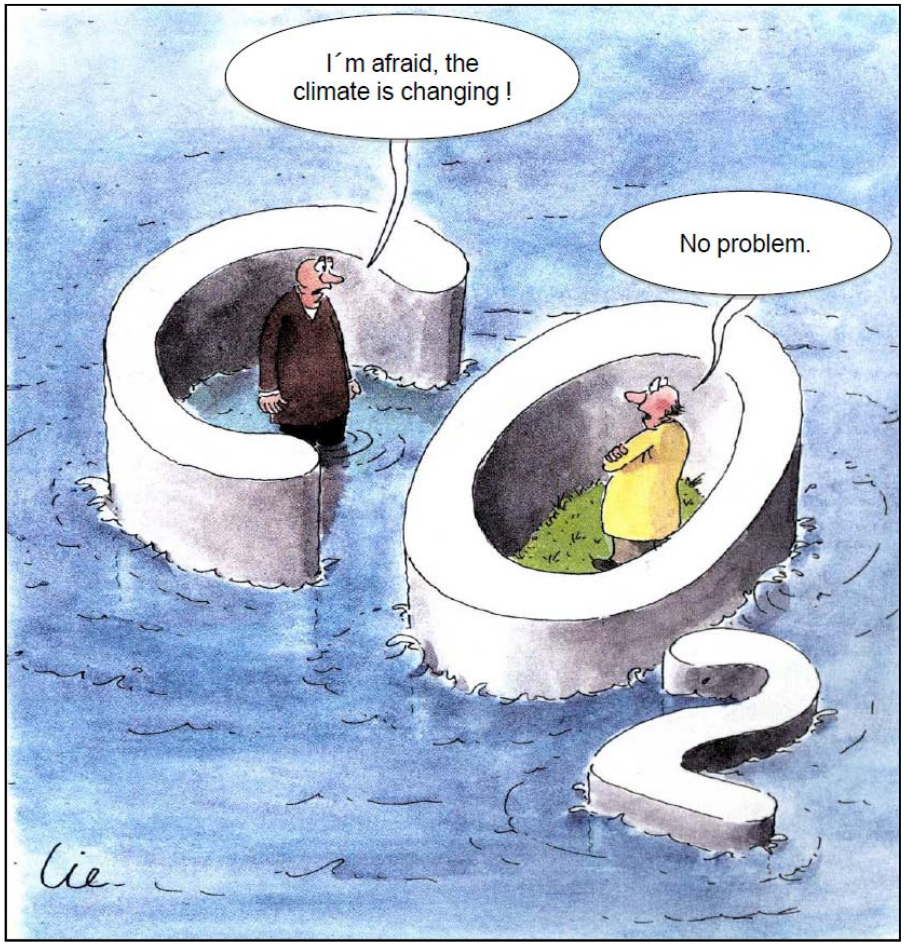
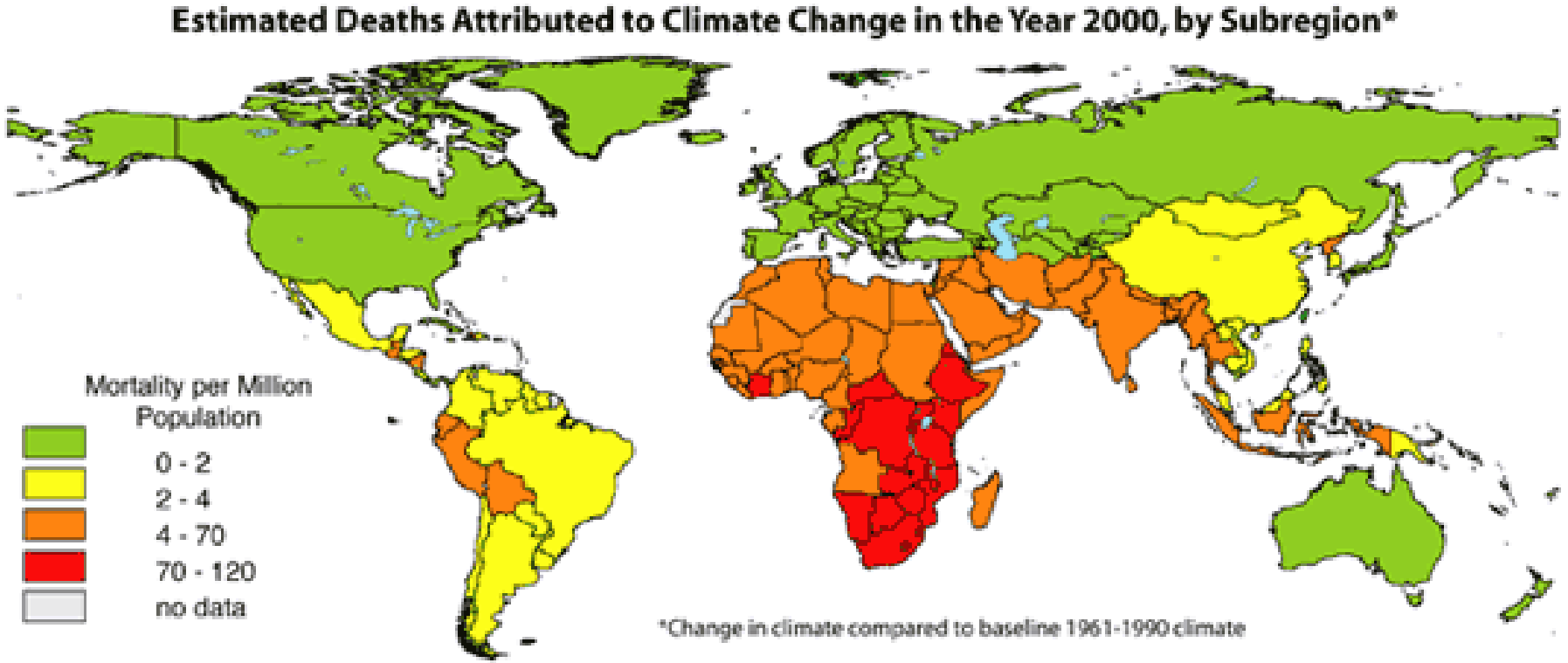
climate change by greenhouse gas emissions



Why is RE interesting for young people?

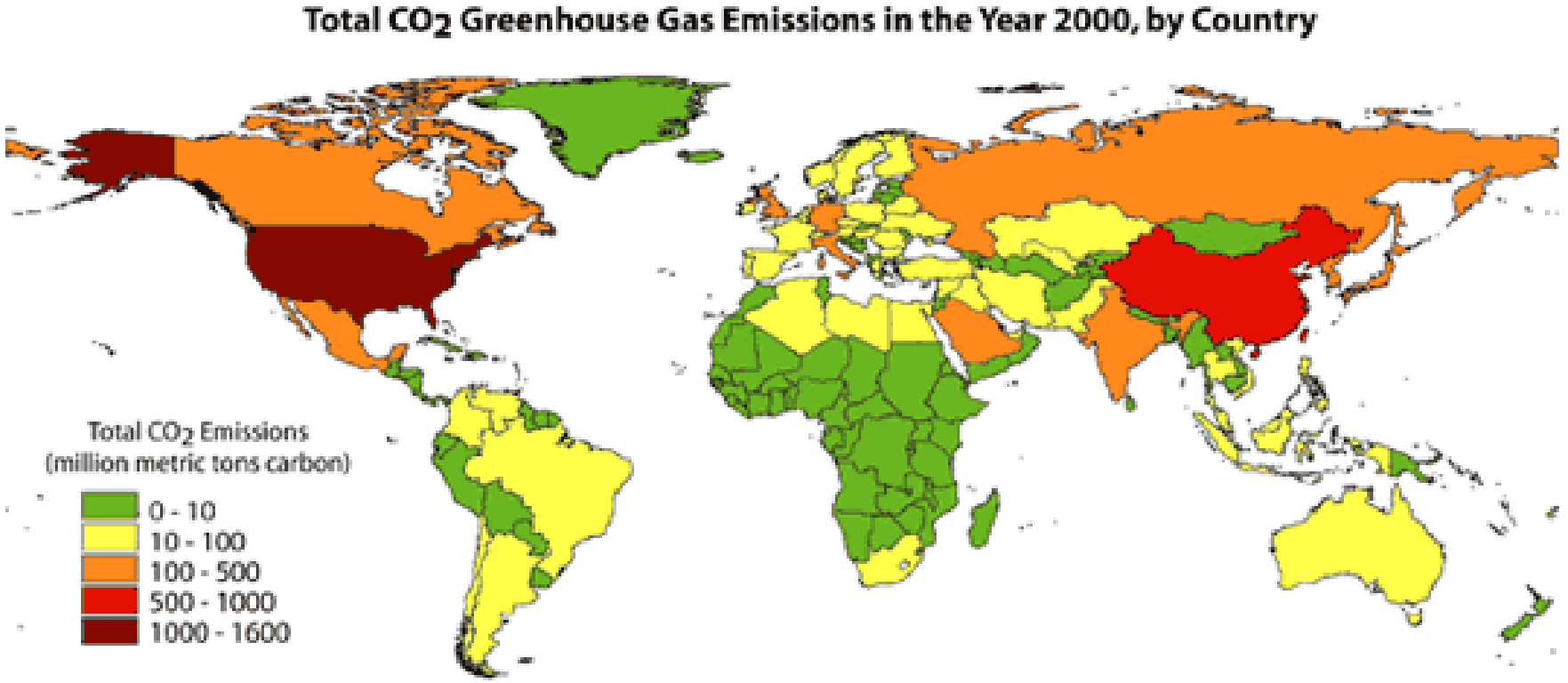
poor countries are suffering from climate change



Source: Press release University of Wisconsin-Madison, November 16, 2005

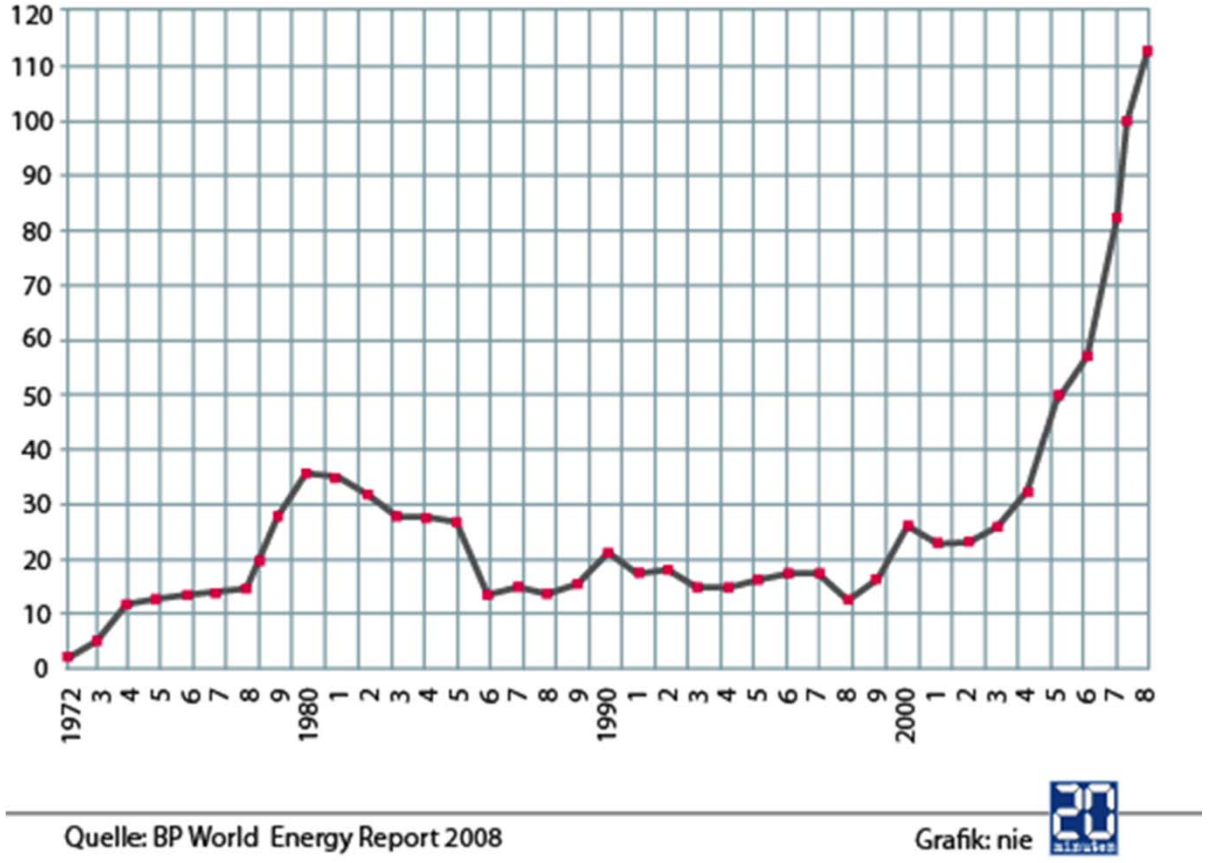
Why is RE interesting for young people?

rich countries are responsible for CO2 emissions



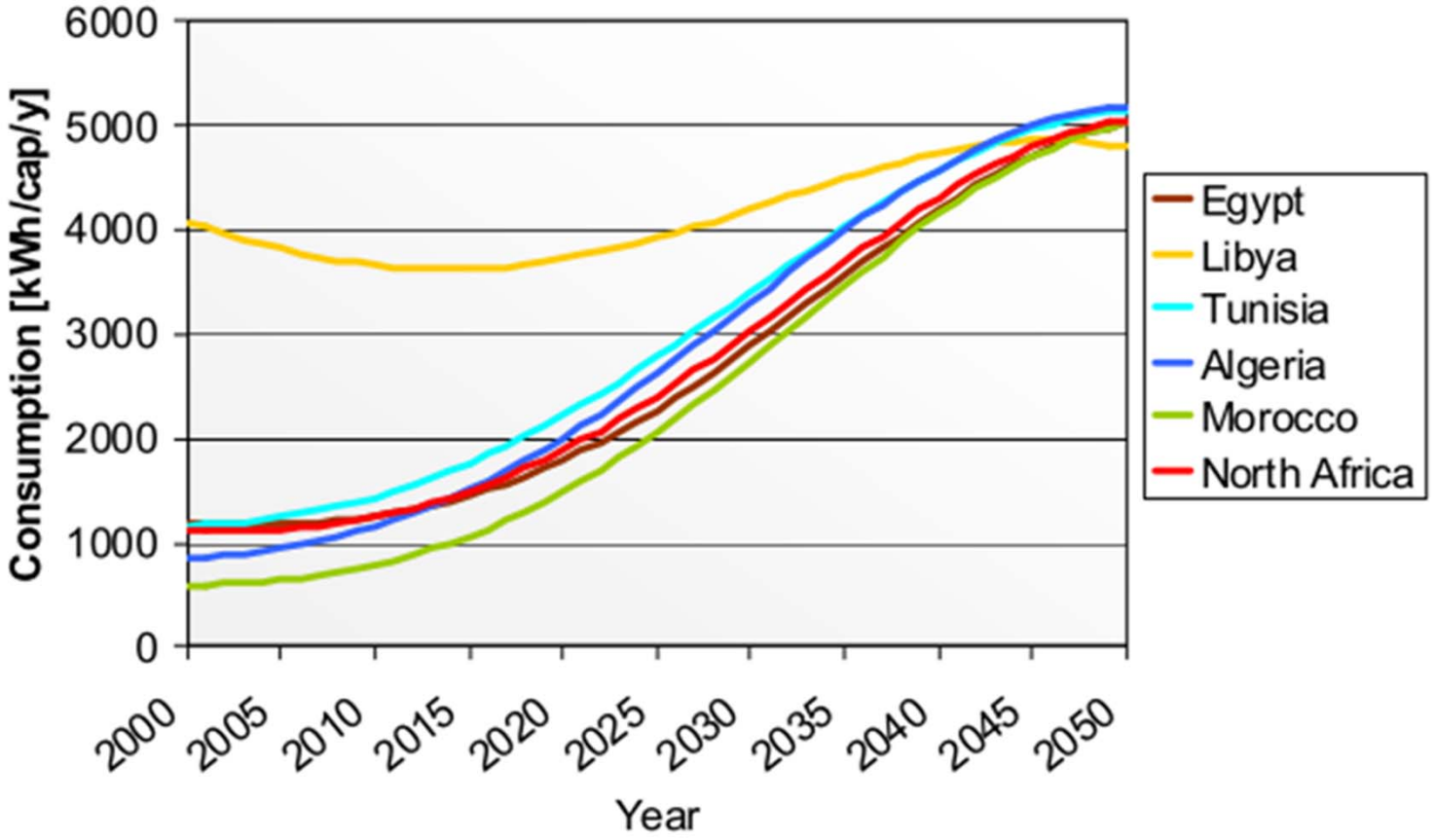
Why is RE interesting for young people?

rising prices for fossil enegy carriers



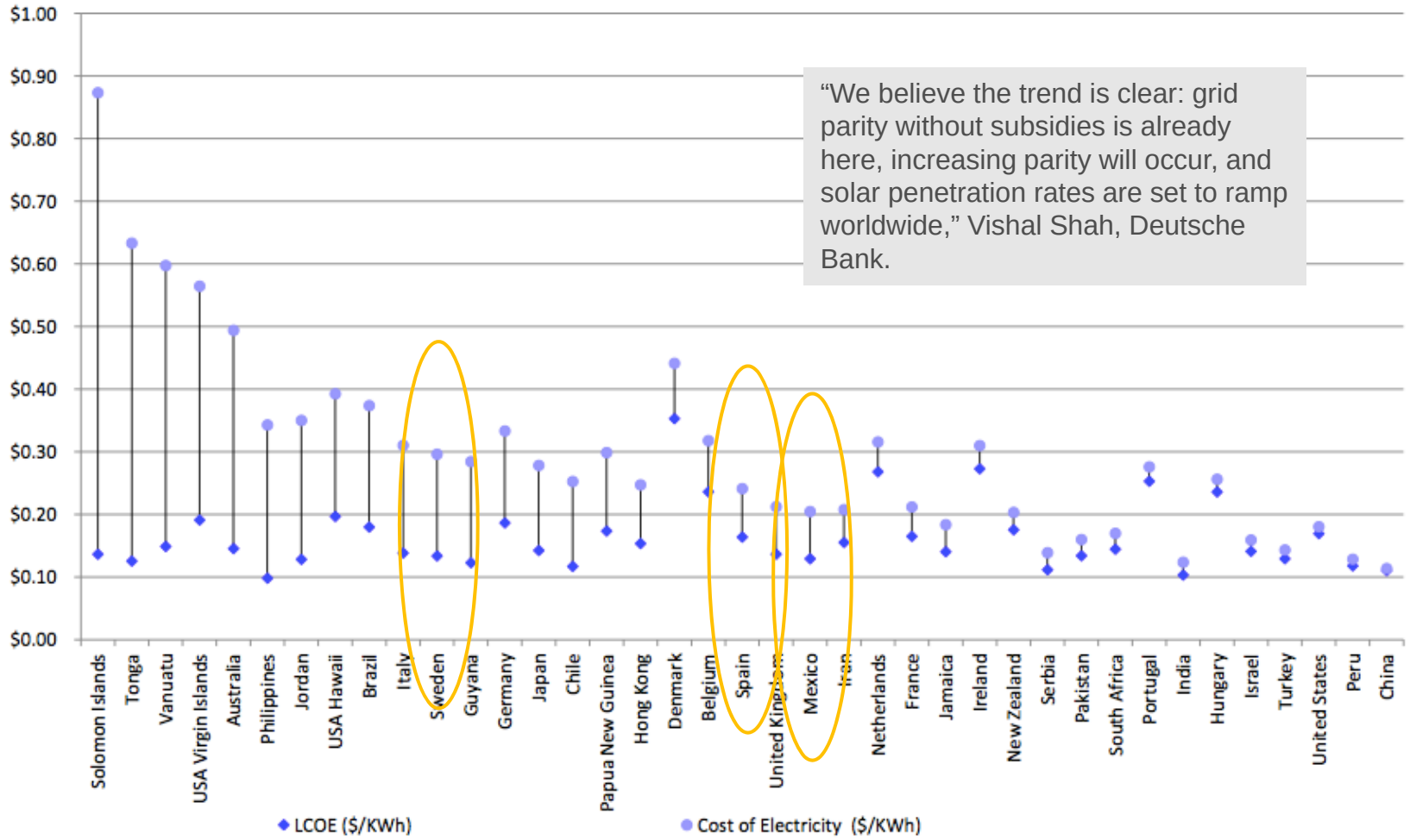
Why is RE interesting for young people?

increasing energy demand in MENA



Why is RE interesting for young people?

PV electricity costs vs. customer costs

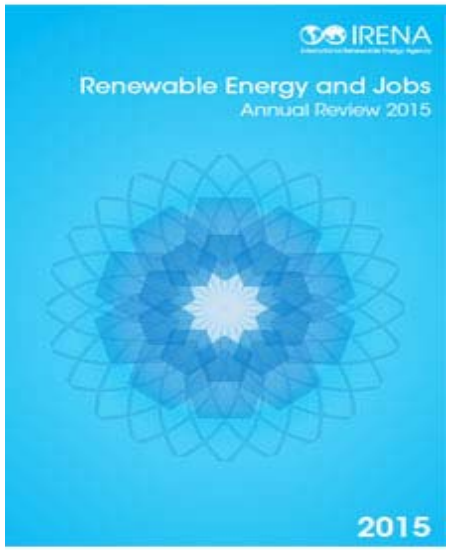


"We believe the trend is clear: grid parity without subsidies is already here, increasing parity will occur, and solar penetration rates are set to ramp worldwide," Vishal Shah, Deutsche Bank.

Source: Deutsche Bank Estimates

Why is RE interesting for young people?

job creation



Renewable Energy and Jobs – Annual Review presents the status of renewable energy employment, both by technology and in selected countries, over the past year. In this second edition, ***IRENA estimates that renewable energy employed 7.7 million people, directly or indirectly, around the world in 2014*** (excluding large hydropower). ***This is an 18% increase*** from the number reported the previous year. In addition, IRENA conducted the first-ever global estimate of large hydropower employment, showing approximately 1.5 million direct jobs in the sector.

The 10 countries with the largest renewable energy employment were China, Brazil, the United States, India, Germany, Indonesia, Japan, France, Bangladesh and Colombia.

The solar PV industry is the largest renewable energy employer worldwide with 2.5 million jobs, followed by liquid biofuels with 1.8 million jobs, and wind power, which surpassed 1 million jobs for the first time. The employment increase extends across the renewable energy spectrum with solar, wind, biofuels, biomass, biogas and small hydropower all seeing increases in employment.

Why is RE interesting for young people?

.....because you
can make
money with it!

Which RE Technologies are useful?

Biomass

Solar Architecture

Hydropower

Wind

Solar thermal

Solar PV

Solar CSP

Which RE Technologies are useful?

Biomass

Solar Architecture

Hydropower

Wind

Solar thermal

Solar PV

Solar CSP

+ easy, small units, storable

- high land use, no building integration

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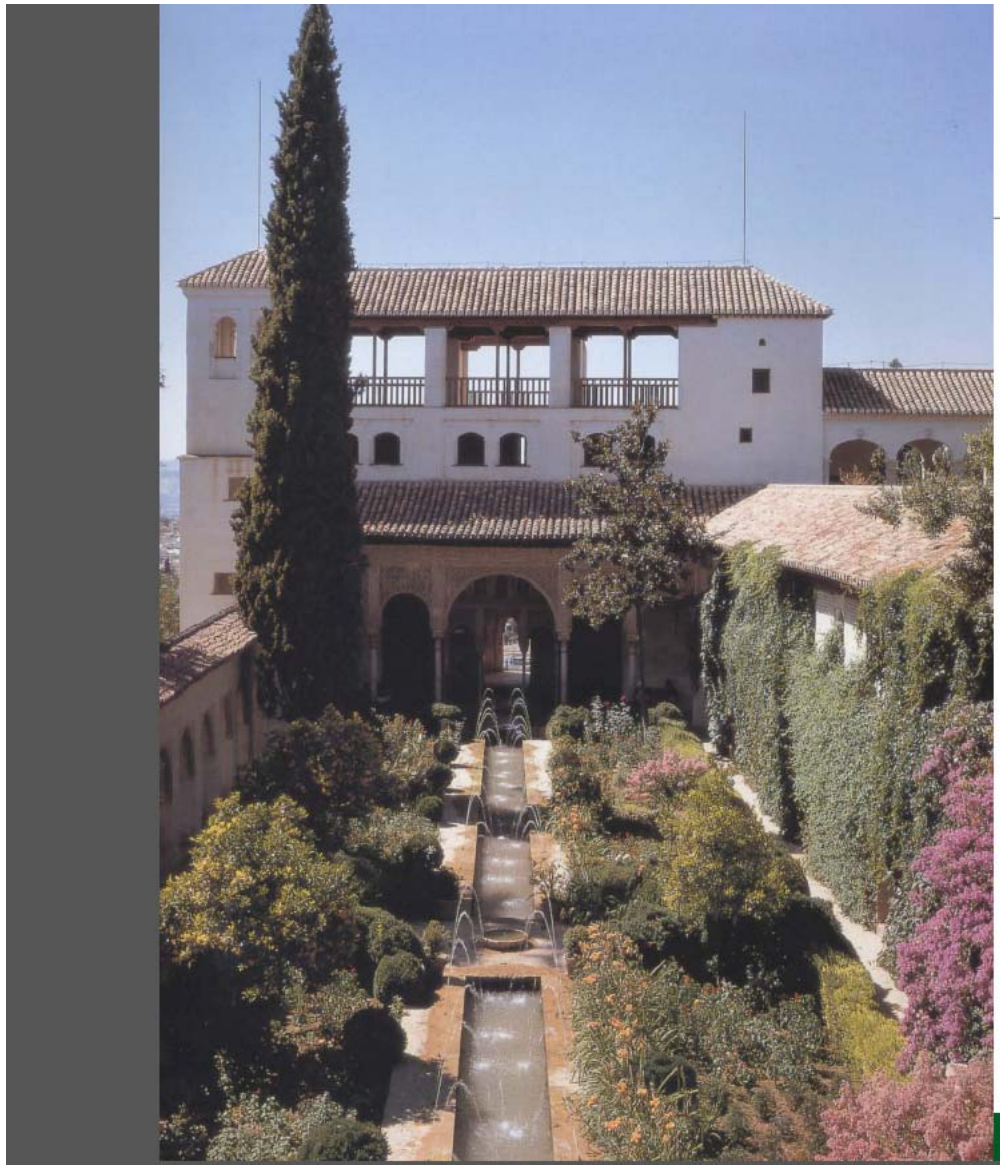
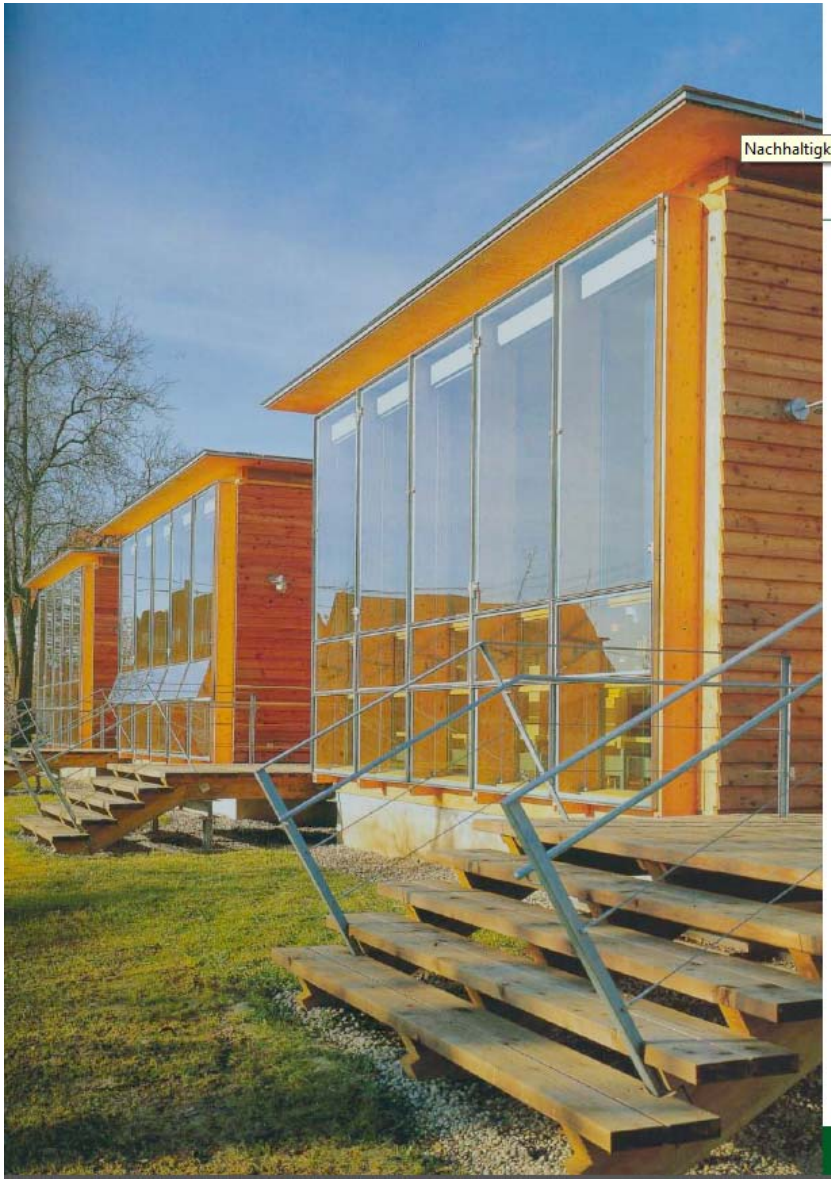
source: Prof. Bombeck, University of Rostock

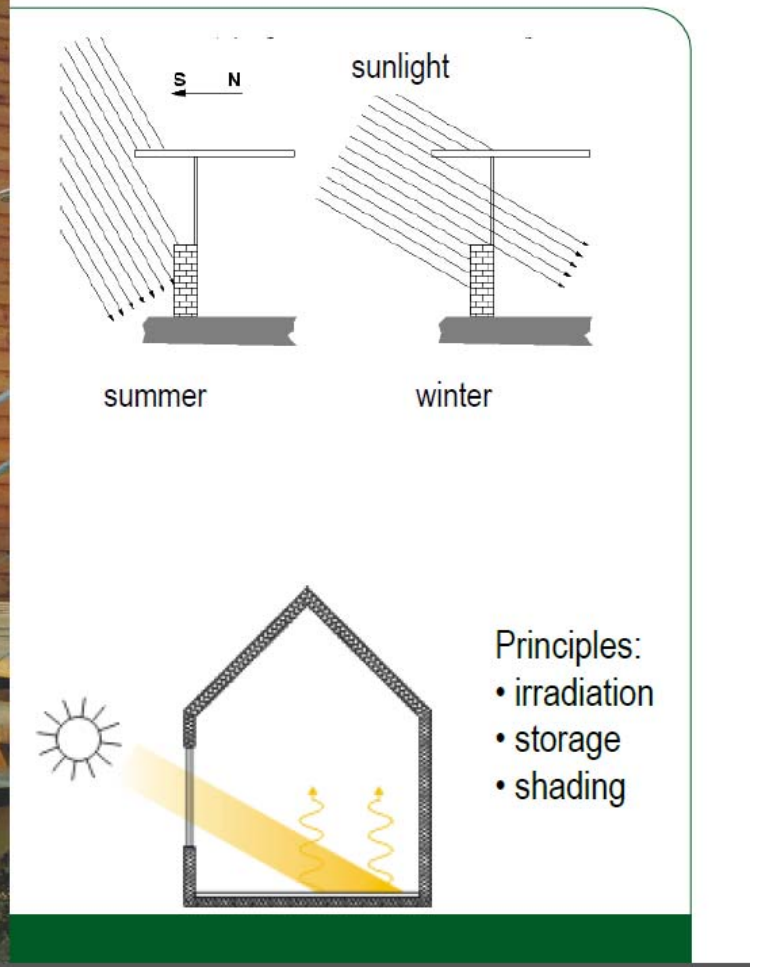


Combined air conditioning Alhambra / Sevillia

- vegetation
- water surfaces
- exposition

source: Prof. Bombeck, University of Rostock





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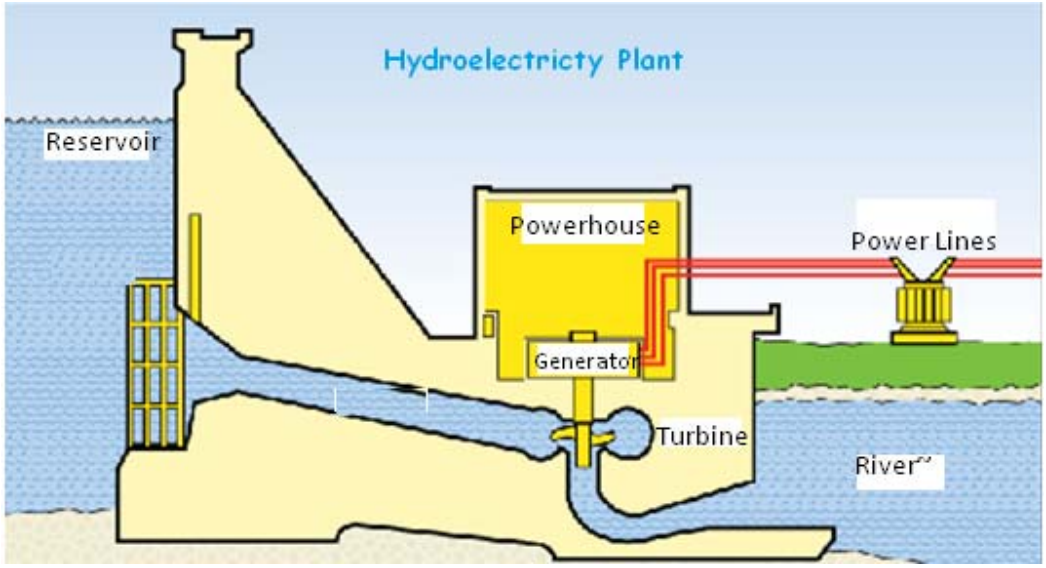

Lake Aswan 2100 MW

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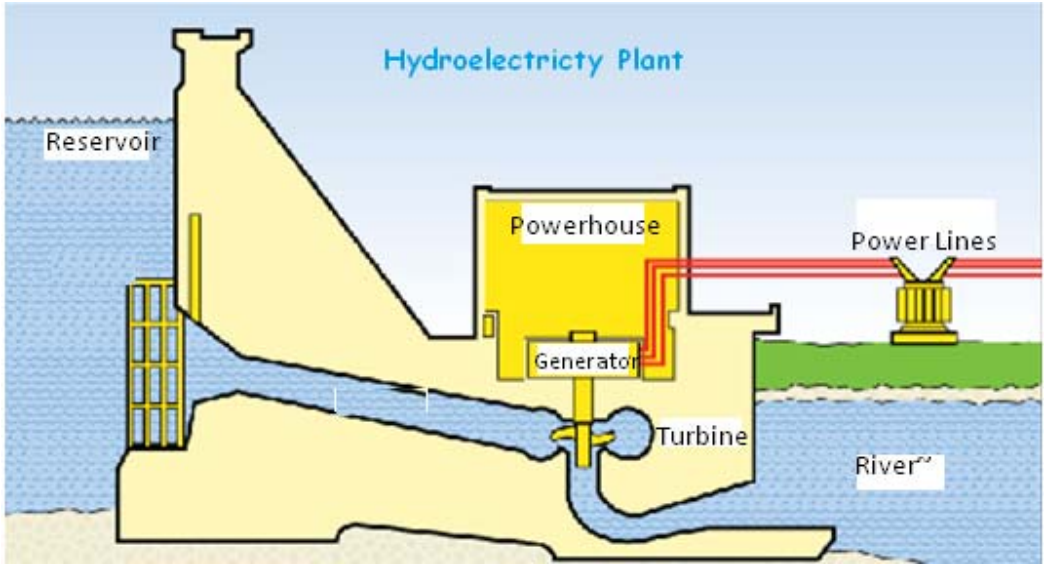

+ storable, energy on demand

-high land use,

-environmental impact, resettlements

-restricted to humid mountain countries

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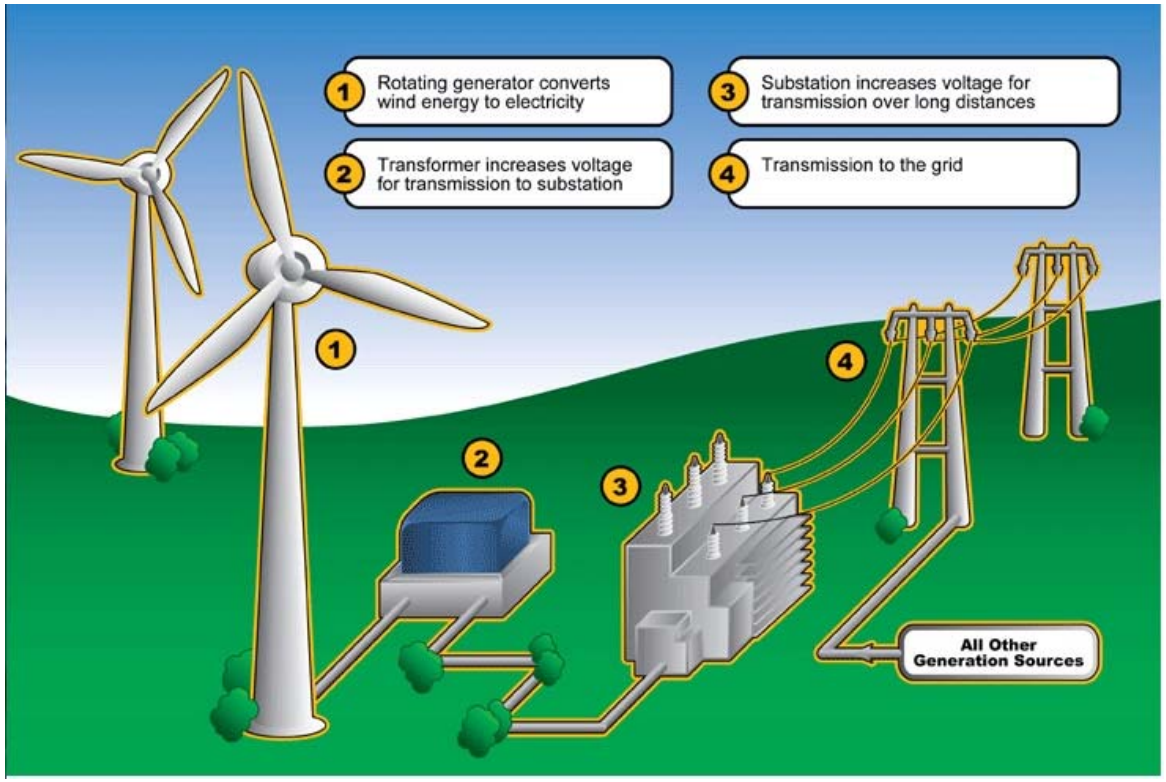

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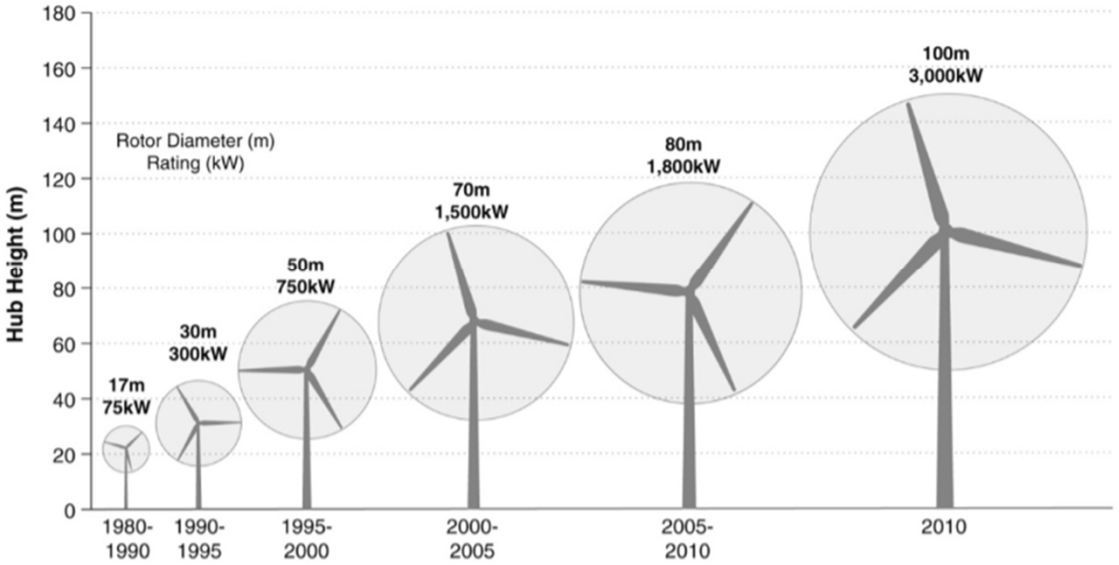

Figure 4. Representative turbine architectures from 1980 to 2010

Source: NREL

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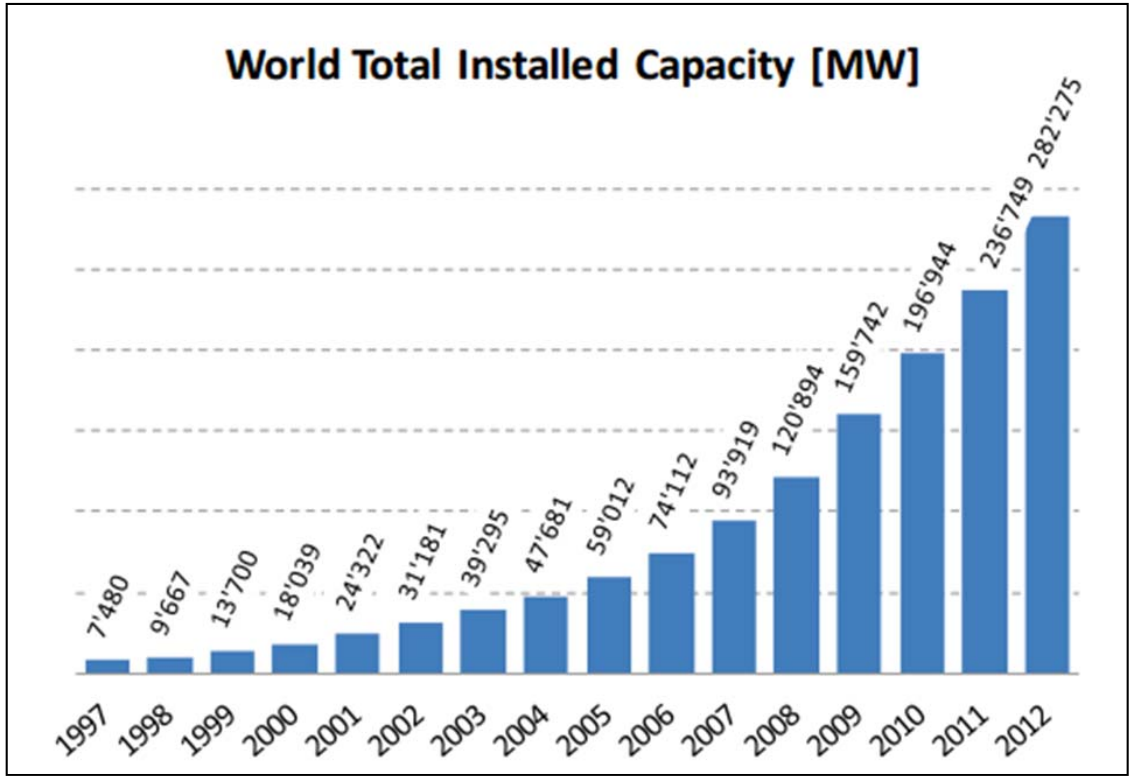

World Wind Energy Association annual Repot 2012

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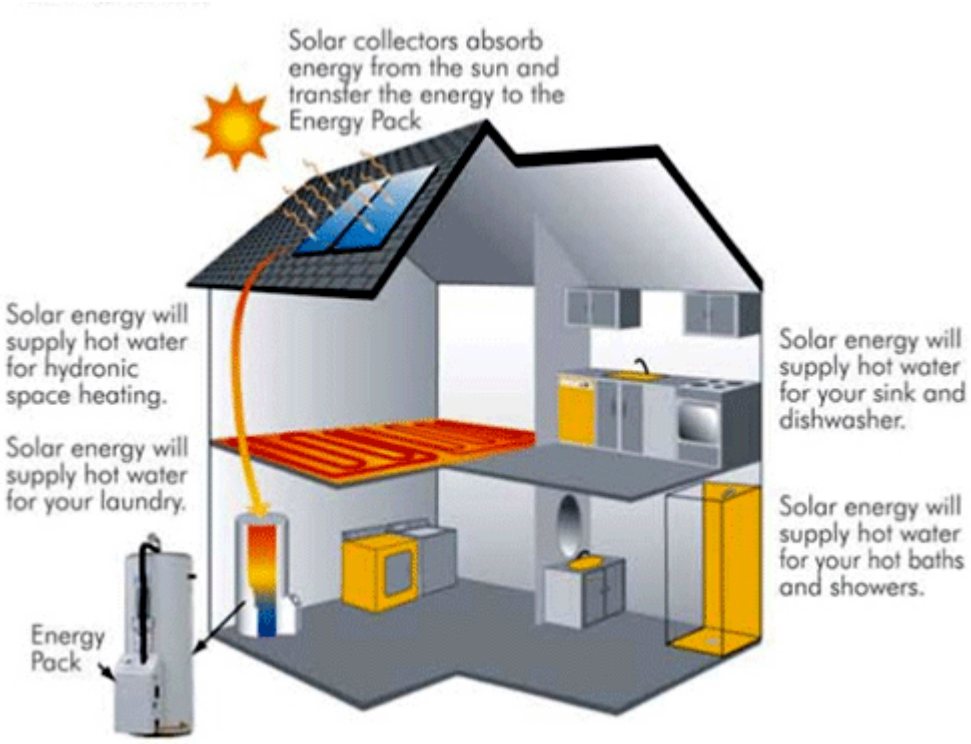

http://www.cityofcalabasas.com/solar.html

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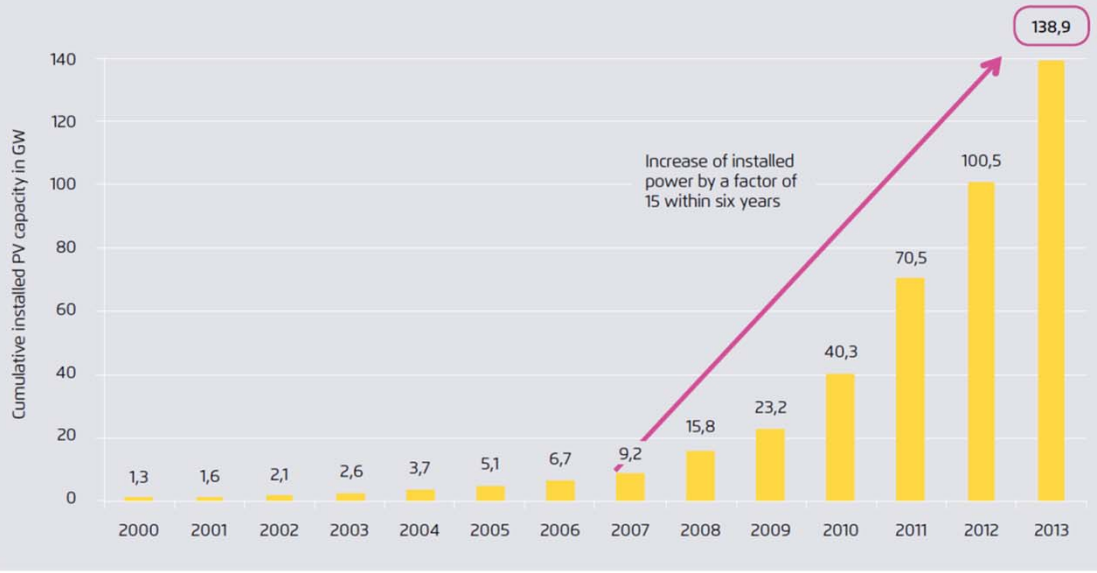
Historical development of installed PV capacity worldwide Figure 7



Own illustration based on data by EPIA [4]

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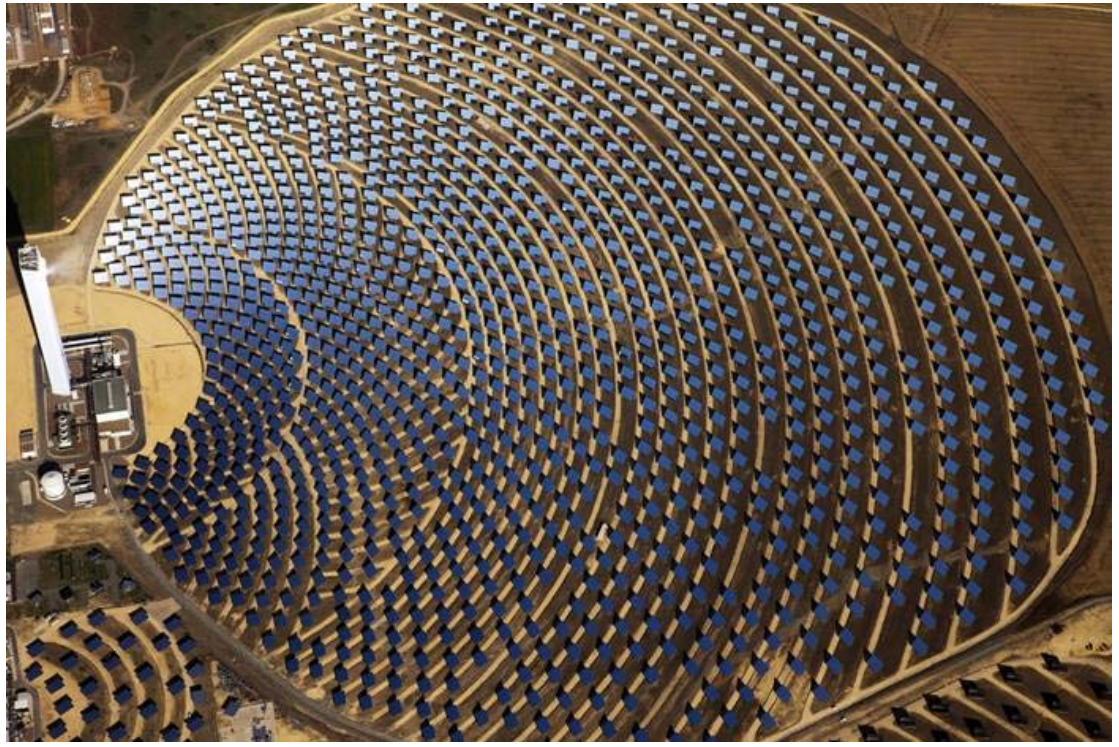
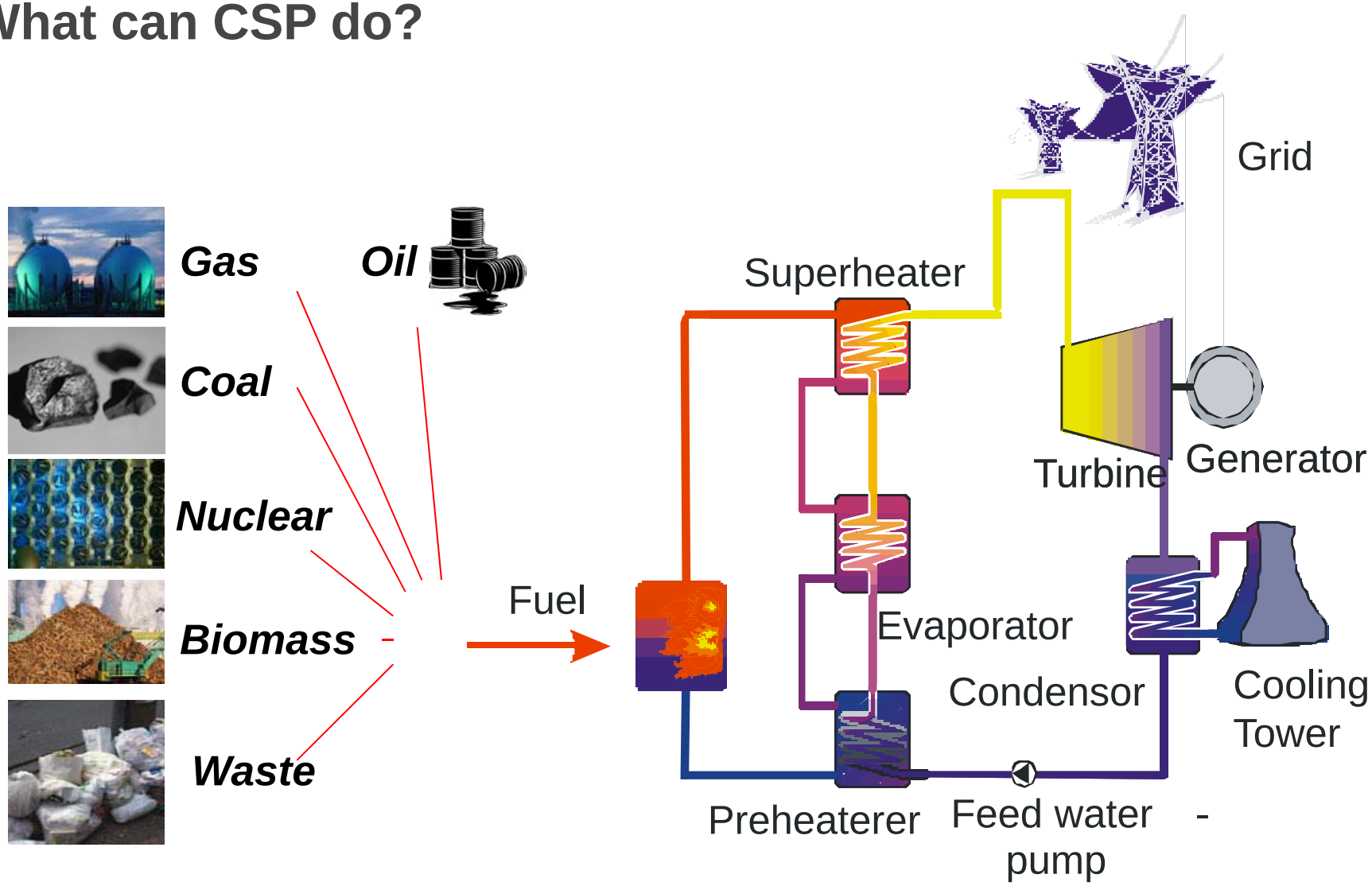


http://forum.xcitefun.net/worlds-first-commercial-solar-power-tower-t87804.html

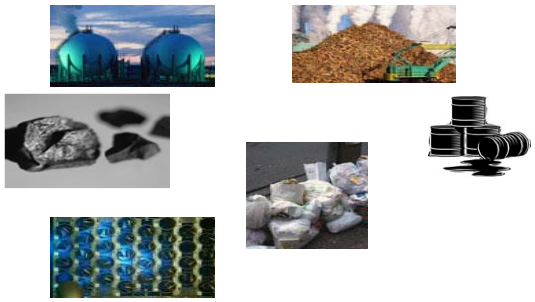
Which RE Technologies are useful?

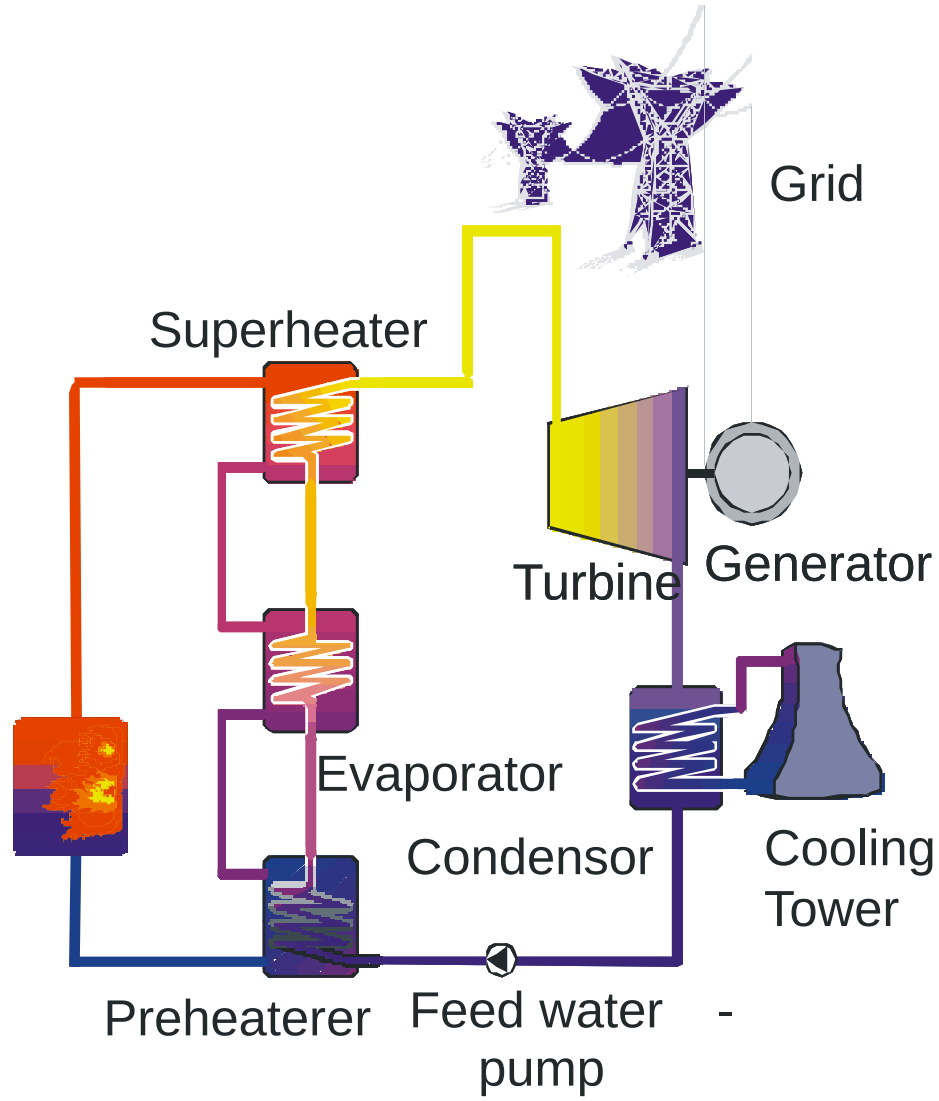
...all of them,
we need a
proper mixture!

What can CSP do?



What can CSP do?

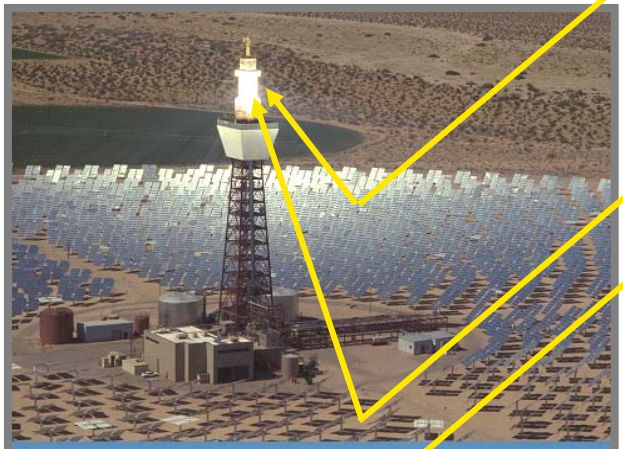




What can CSP do?

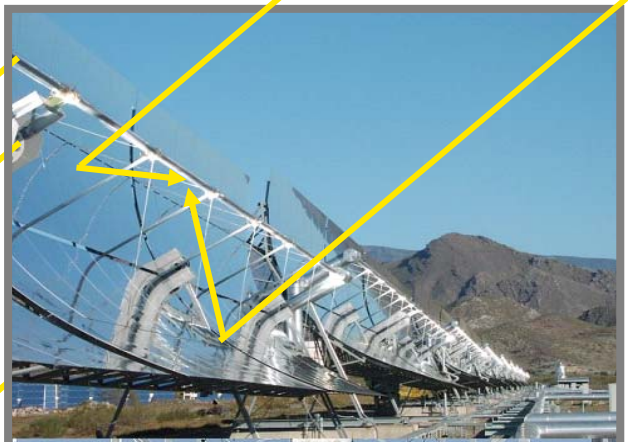
Up to 1000 ° C Gas turbines, Motors

Solar tower (SNL)



Dish-Stirling (SBP)

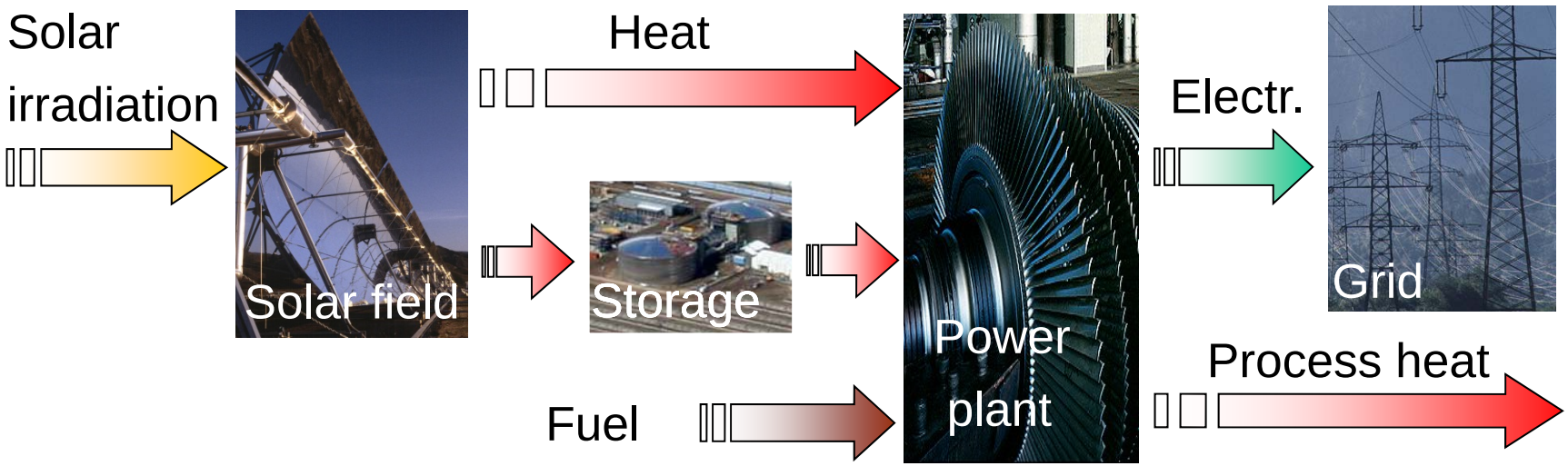
Parabolic trough (PSA)



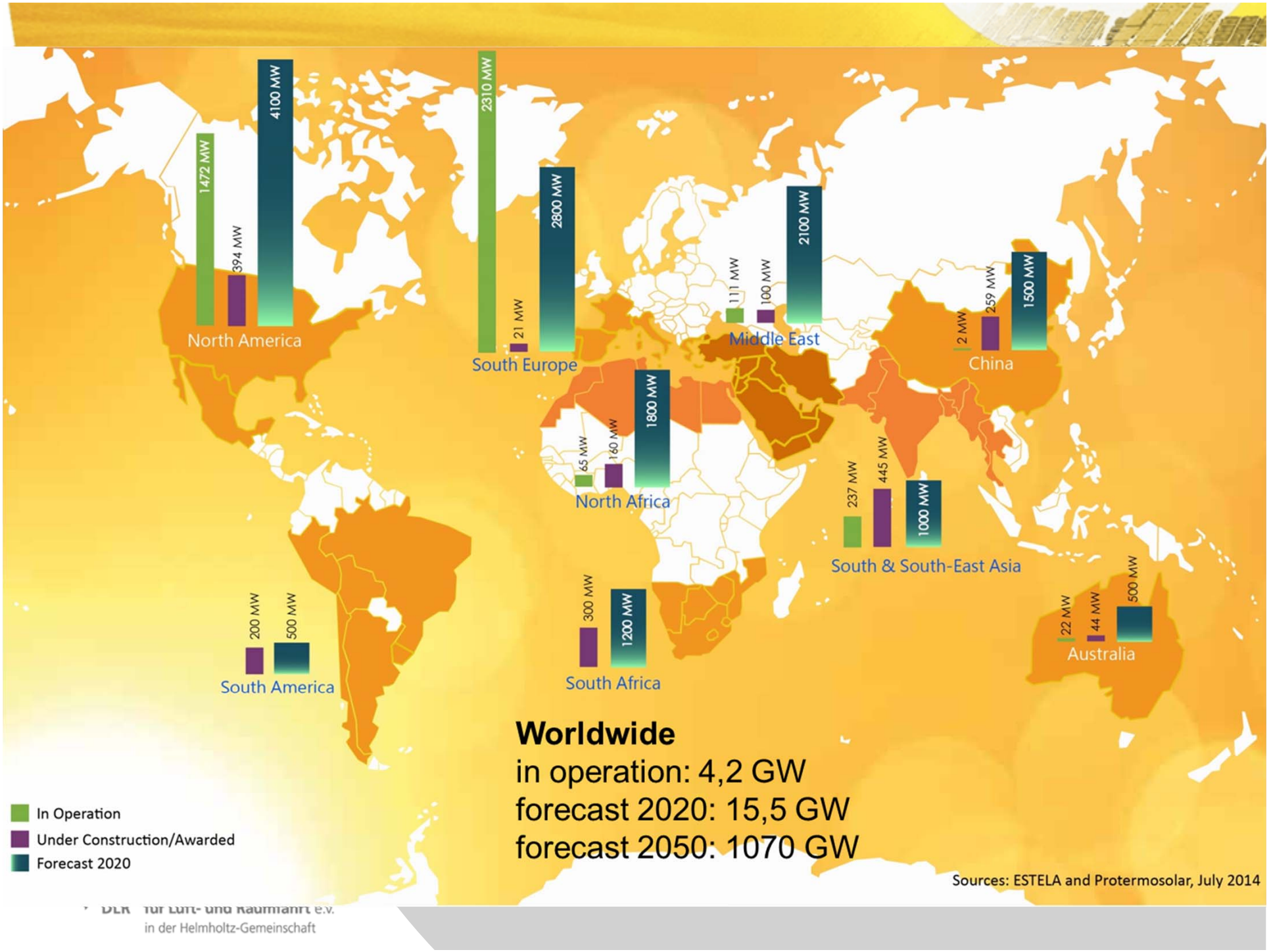
Linear Fresnel (MAN/SPG)

Up to 550 ° C steam turbines

What can CSP do?



- optional thermal storage or hybrid operation
- heat extraction for process heat, cooling, seawater desalination


1472 MW
394 MW
4100 MW
North America
2310 MW
21 MW
2800 MW
South Europe
111 MW
100 MW
2100 MW
Middle East
2 MW
259 MW
1500 MW
China
65 MW
160 MW
1800 MW
North Africa
237 MW
445 MW
1000 MW
South & South-East Asia
200 MW
500 MW
South America
300 MW
1200 MW
South Africa
22 MW
44 MW
500 MW
Australia
In Operation
Under Construction/Awarded
Forecast 2020
Worldwide
in operation: 4,2 GW
forecast 2020: 15,5 GW
forecast 2050: 1070 GW
Sources: ESTELA and Protermosolar, July 2014

What can CSP do?

Current project in MENA: Ain Beni Matar (Morocco)

- Combined Cycle + Solar field (ISCCS)
- Owner: ONE
- EPC conventional CC-plant: Abener
- EPC solar field + 2 year O&M: Abener
- Groundbreaking: 2008
- Commissioning: 5/2011
- Solar field size: 180.000 m²
- Solar share (yearly): 4%

an overview on CSP-projects in the world is given by

www. solarpaces.org

social.csptoday.com/

www.cspworld.org

What can CSP do?

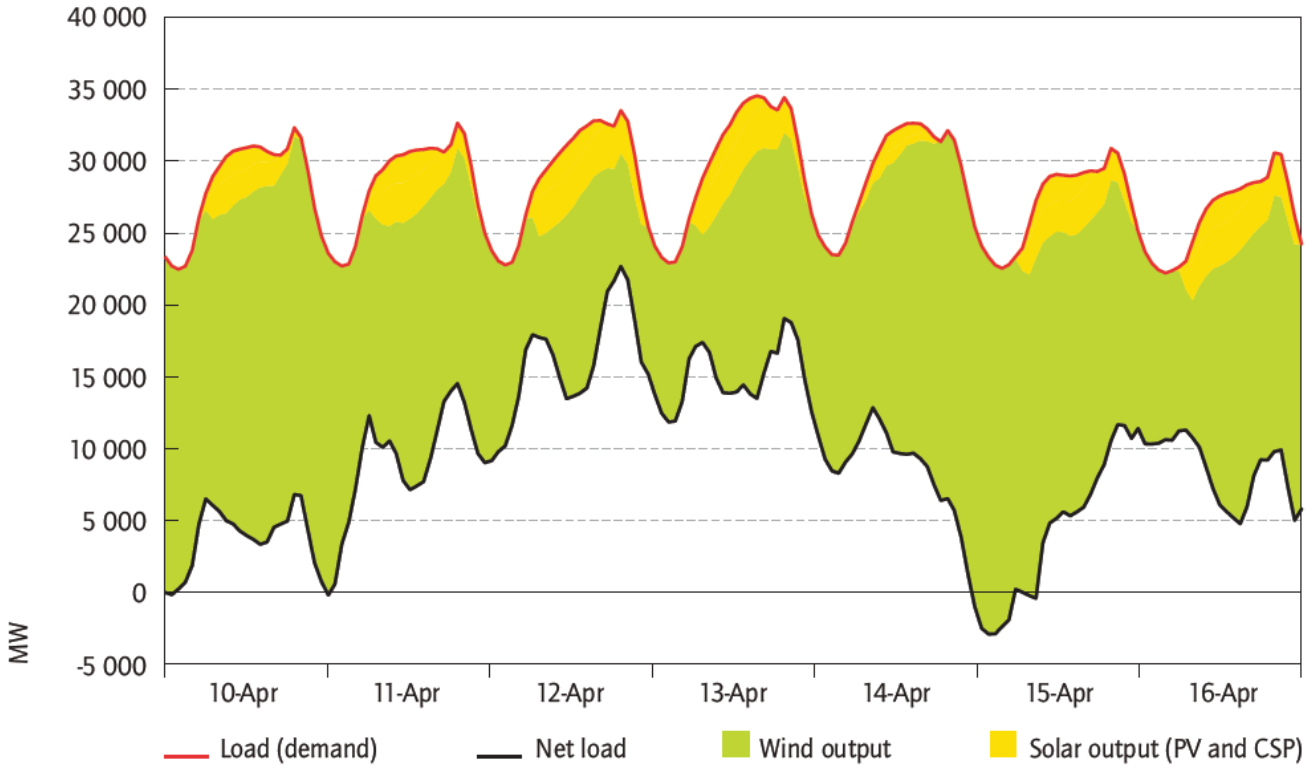
...provide renewable ***base load electricity*** or ***power on demand***!

Why are RE important for MENA and EU?

- The German nuclear power exit strategy
  - All nuclear power stations will be switched off by 2022
- Energy concept 2050: 100% Renewable Energy
- Dependence on weather conditions
- Coverage of ***residual load*** necessary

Why are RE important for MENA and EU?

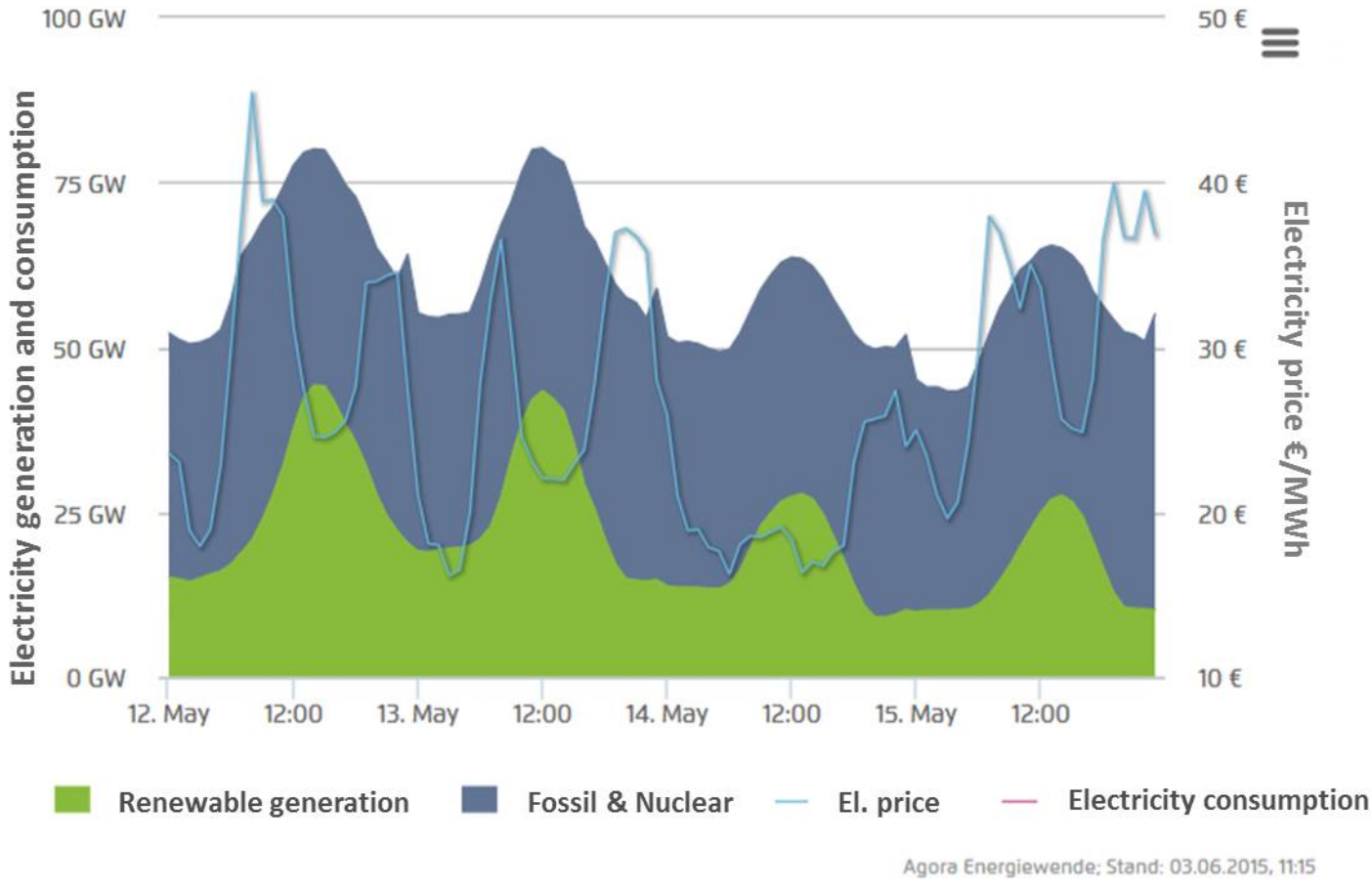
Residual load problem from 35% wind and PV



Source: GE Energy, 2010.

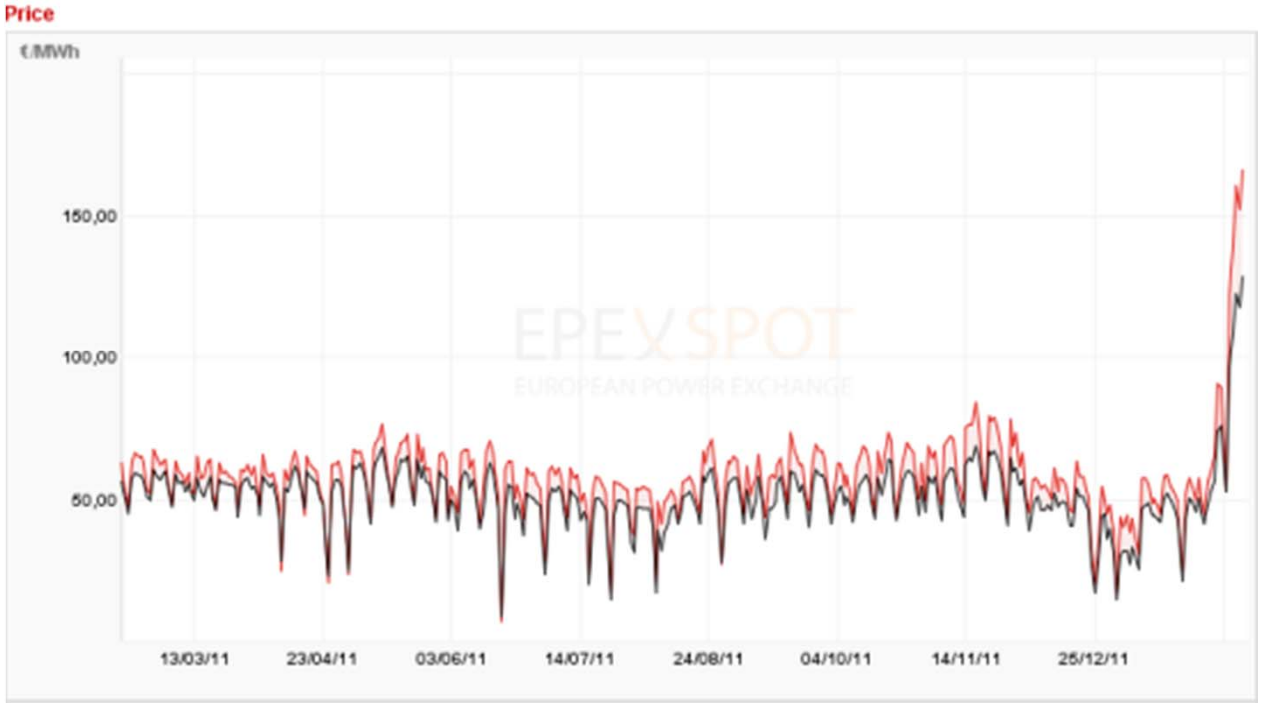
Why are RE important for MENA and EU?

Residual load and price peaks



Why are RE important for MENA and EU?

Price peaks in the electricity market

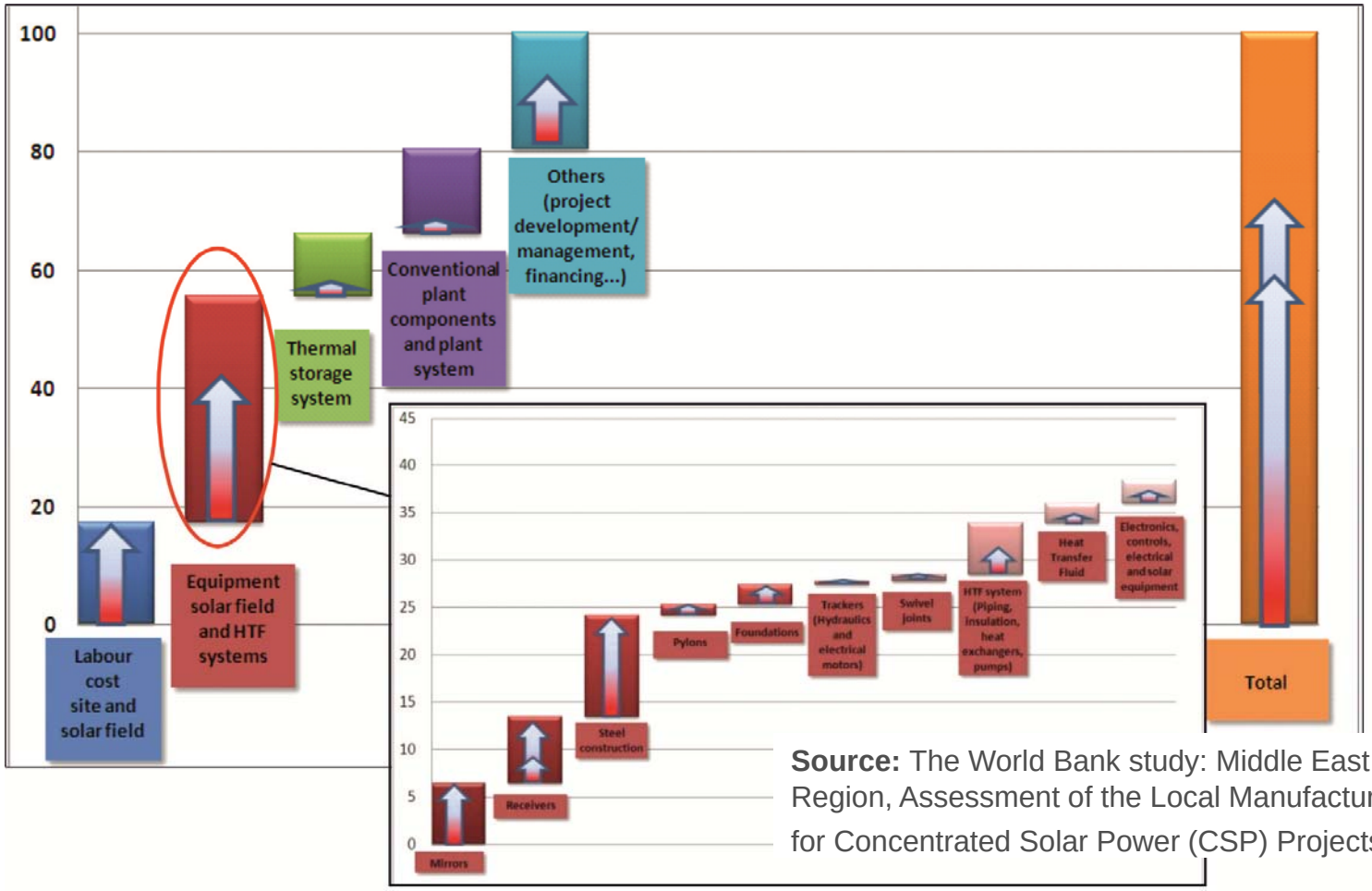


Why are RE important for EU and MENA

- Solar Thermal power plants with thermal storage
- The DESERTEC Concept
- EU-Mena partnerships
- Improvement of Infrastucture (HVDC lines)

Why are RE important for EU and MENA

Local Manufacturing Potential



Source: The World Bank study: Middle East and North Africa Region, Assessment of the Local Manufacturing Potential for Concentrated Solar Power (CSP) Projects

Why are RE important for EU and MENA

...because MENA countries and EU may develop electricity exchange in win-win partnerships!

How can we support RE in EU and MENA?

- Supporting the Sustainable Implementation of Solar Thermal Power Plants Technology in the MENA Region

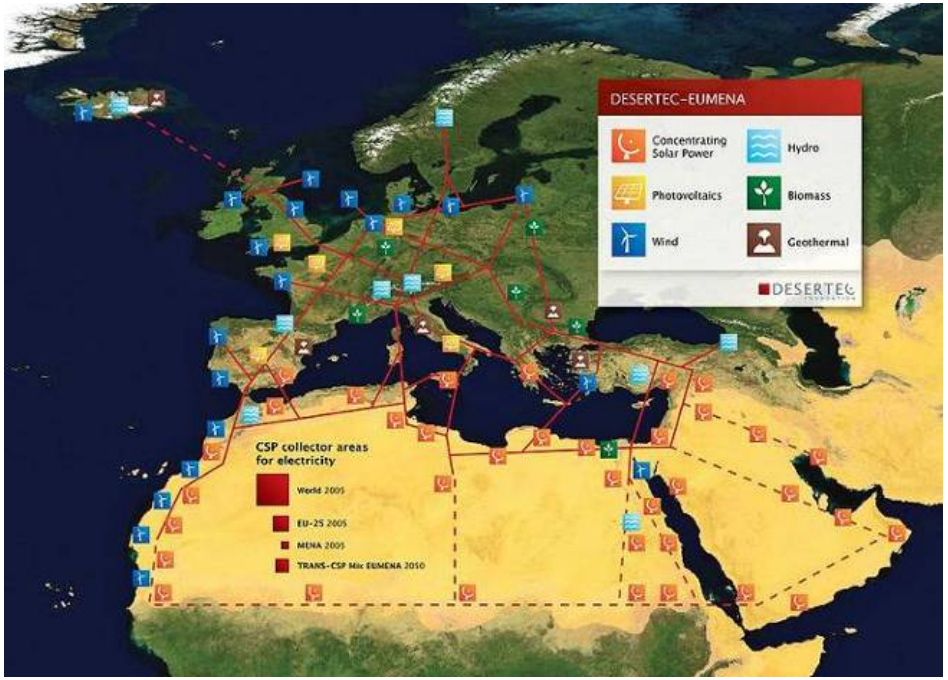
How can we support RE in EU and MENA?

enerMENA 2009 – 2014

enerMENA follows the DESERTEC concept

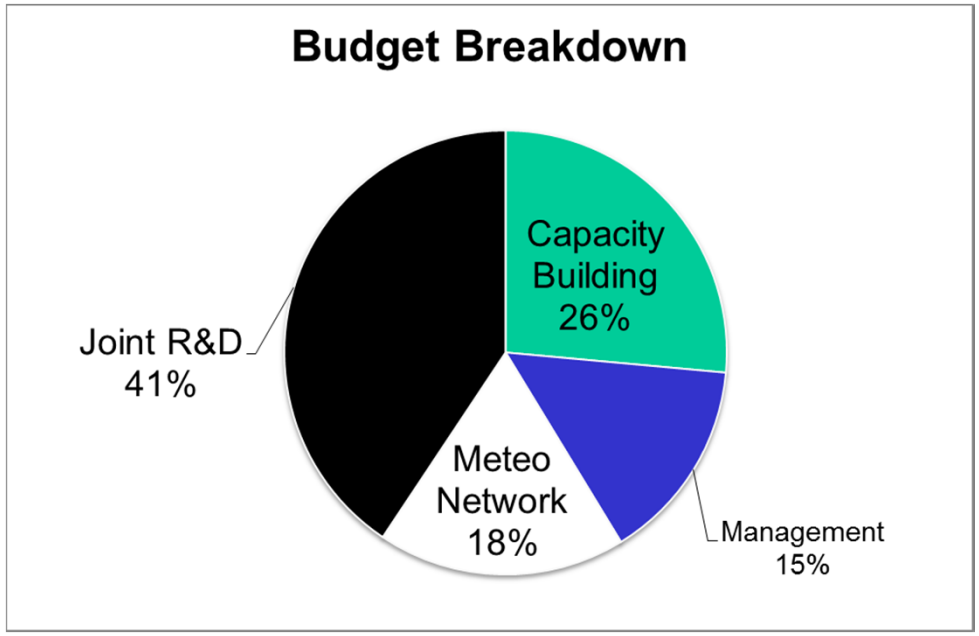
enerMENA supports the Sustainable Implementation of Solar Thermal Power Plants Technology in the MENA

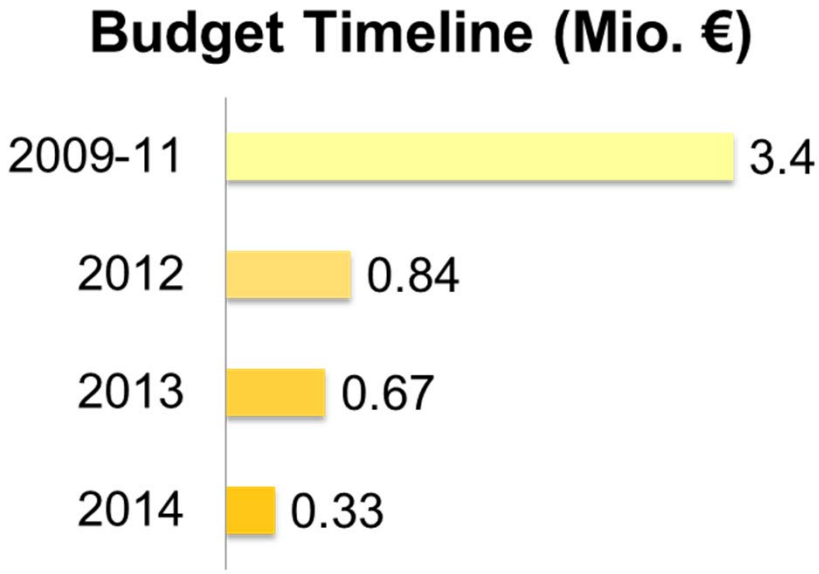
enerMENA is a DLR initiative, supported by the German Federal Foreign Office



How can we support RE in EU and MENA?

enerMENA Budget





How can we support RE in EU and MENA?

enerMENA actions: R&D Bypass

- **Motivation:**

  Increase solar field performance under operation conditions

- **Set–Up**

  HTF Bypass between header and loop, equipped with different flow meters

- **Achievements**

  Installed at ISCCS Kuraymat in cooperation with NREA

  Joint measurements and capacity building

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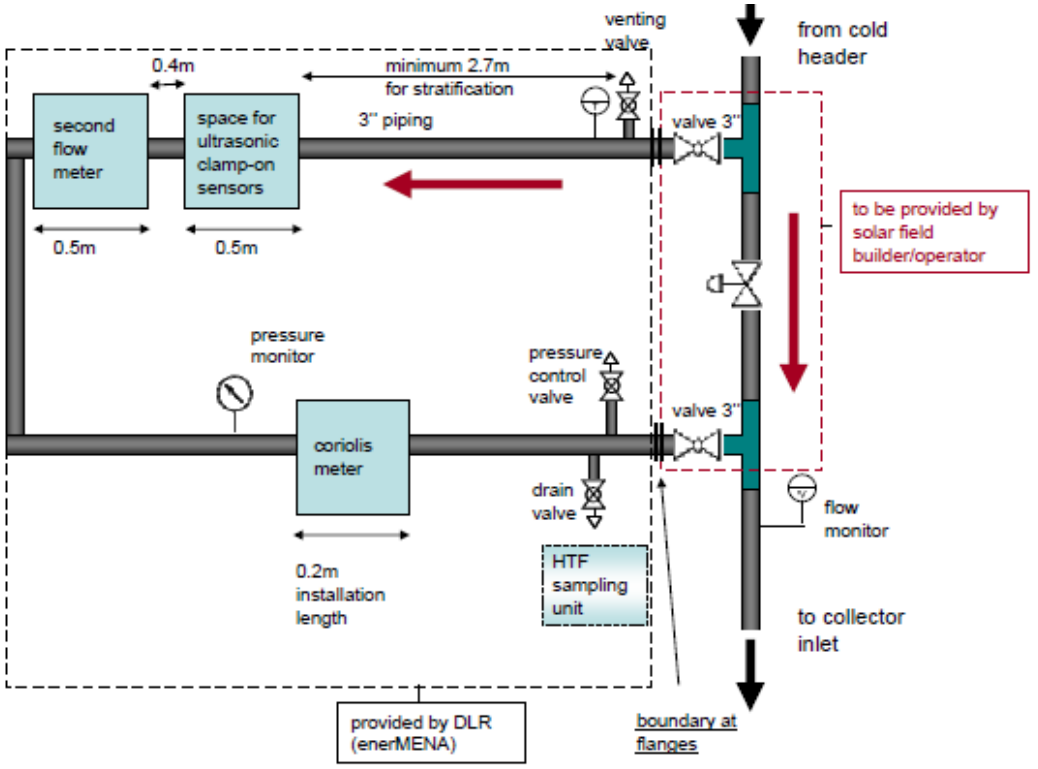
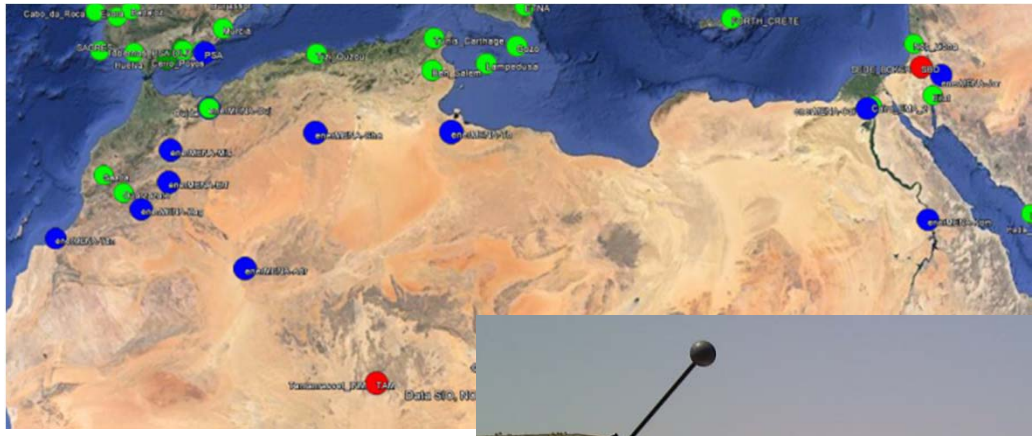


How can we support RE in EU and MENA?

enerMENA actions: Network of Meteo stations

- **Motivation:**
  - Solar resource assessment for R&D and future CSP projects
- **Set – Up**
  - 11 Stations in 5 countries
  - DNI, GHI
  - Optional: soiling, durability, extinction parameters
- **Achievements**
  - 24,5 data year accumulated
  - Data has been used by researchers and project developers



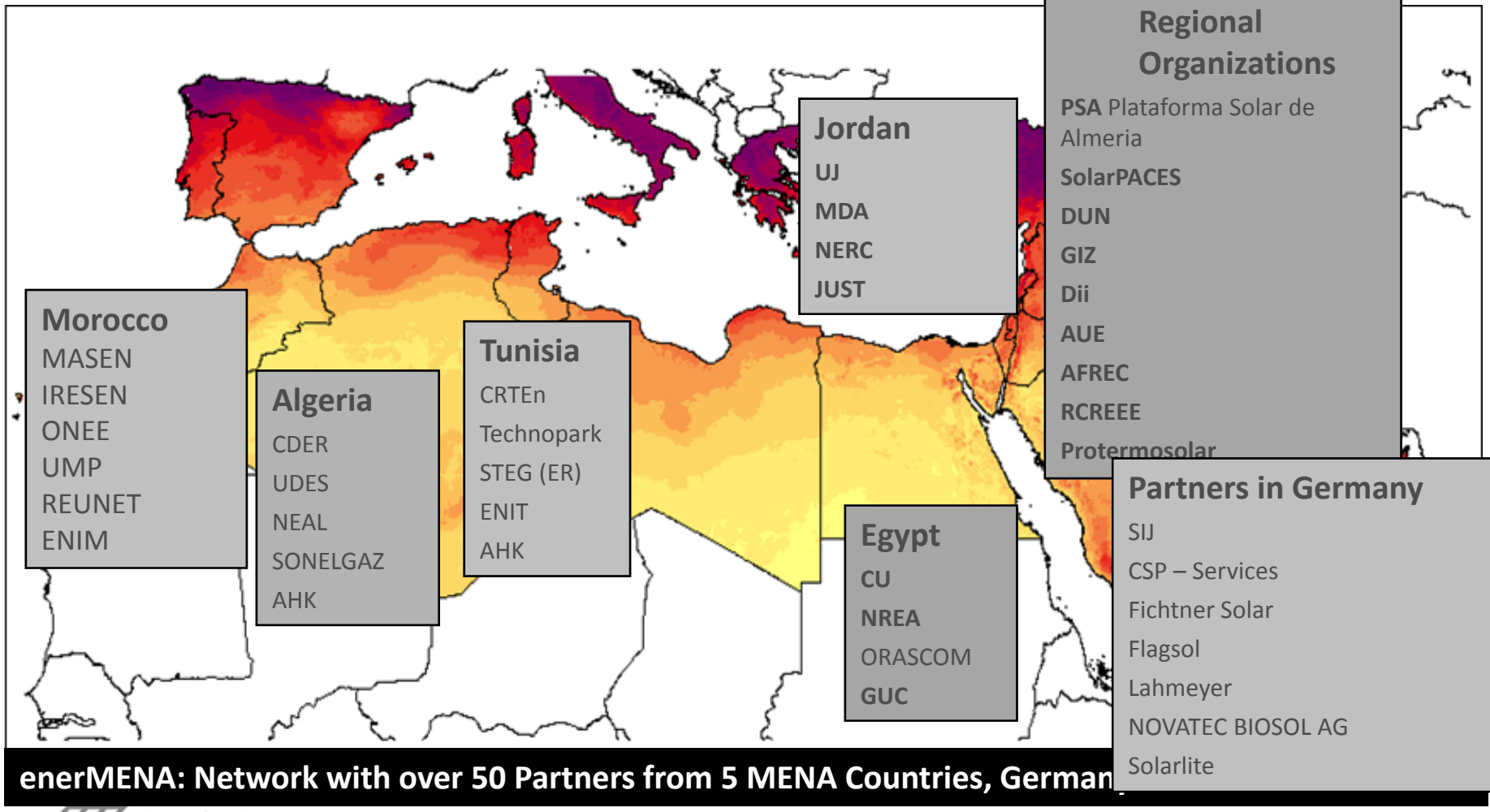
How can we support RE in EU and MENA?

enerMENA actions: Capacity Building

- **Motivation:**
  Establish technical teams to disseminate the CSP know-how and to perform R&D and O&M optimization
- **Implementation**
  Tailor-made courses and teaching materials for each target group (decision makers, project developers, lecturers, engineers and students)
- **Achievements**
  Since 2010 more than 1000 persons have directly participated in enerMENA capacity building

How can we support RE in EU and MENA?

enerMENA network



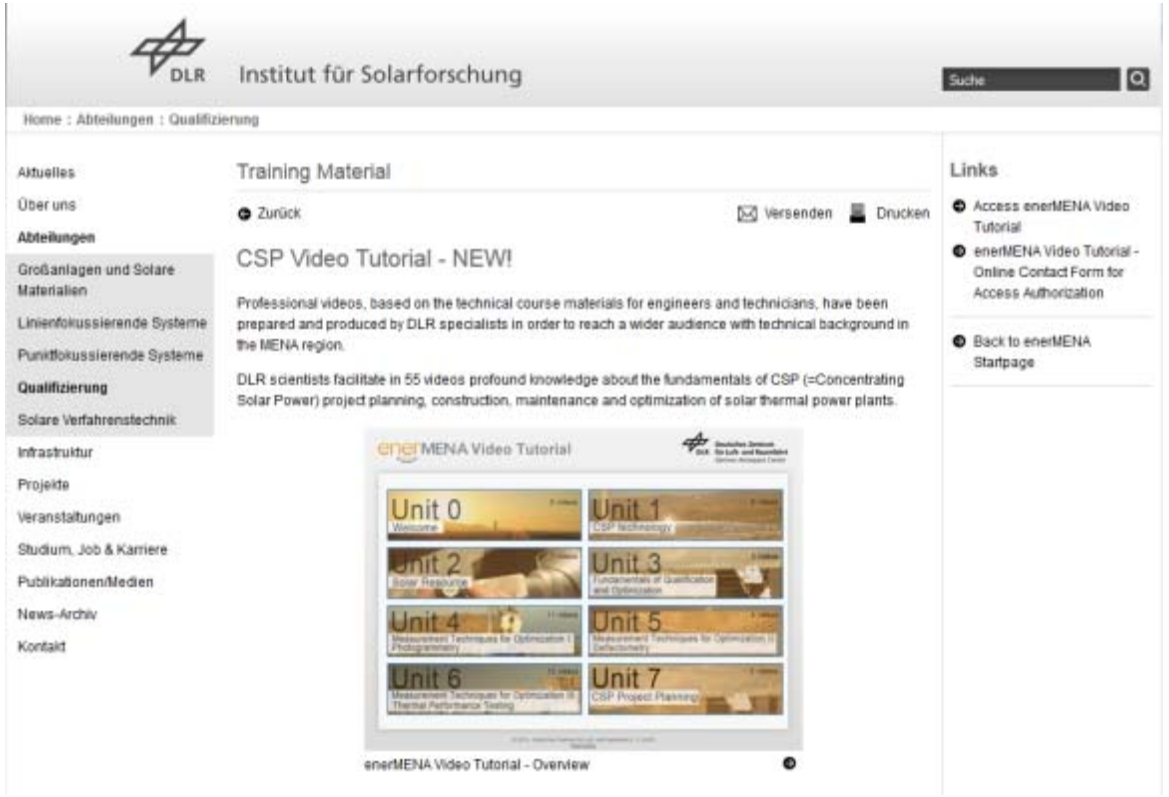
enerMENA: Network with over 50 Partners from 5 MENA Countries, German

How can we support RE in EU and MENA?

teaching materials: technicians & engineers

Video-Tutorials

Material	55 Session, total Time: 15:44:22
# Downloads	220 (29 from MENA countries)
Website	http://www.dlr.de/sf/desktopdefault.aspx/tabid-8679/14935_read-37653



How can we support RE in EU and MENA?

teaching materials: universities

Scripts	927 pages 1541 slides
Universities using the teaching materials	34
Website	http://www.dlr.de/sf/desktopdefault.aspx/tabid-8716
Current Distribution countries	enerMENA Partners + Germany
Future Distribution countries	Brazil, Chile

How can we support RE in EU and MENA?

Capacity building courses

	eM-CB	eM-Project	eM-Expert	eM-University	Student Training Courses
Year and Place	2010 Almeria 2011 Tunis 2012 Kairo 2013 Almeria	2013 Amman 2013 Rabat 2013 Cairo	2011 Tunis 2011 Amman 2012 Rabat 2012 Tunis 2013 Amman 2013 Amman 2014 Cologne	2011 Rabat 2011 Amman 2012 Oujda 2012 Algiers 2014 Tunis	2012 Almeria 2013 Almeria 2013 Settat
Scope	Optimization and operation of solar thermal power plants	Project planning of solar thermal power plants	Overview on CSP technologies Project planning for decision makers	Preparation and implementation of teaching materials	Practical training and experiments
Target	Engineers technicians	Project developers Engineers	Decision makers Project developers	Professors Lecturers	Students
participants	54	35	410	237	70

How can we support RE in EU and MENA?

...by initiating co-operations in education, R&D and project development!

Thank you for your attention!

German Aerospace Center, Institute of Solar Research, Köln, Germany and Almeria, Spain
http://www.dlr.de/sf/en/